2. SITE DESCRIPTION AND BACKGROUND

2.1 Site Background

The INEEL is a government-owned facility managed by the United States Department of Energy (DOE). The eastern boundary of the INEEL is located 52 km (32 mi) west of Idaho Falls, Idaho. The INEEL site occupies approximately 2,305 km^2 (890 mi^2) of the northwestern portion of the Eastern Snake River Plain in southeast Idaho. The INTEC facility covers an area of approximately 0.39 km^2 (0.15 mi^2), and is located approximately 72.5 km (45 mi) from Idaho Falls, in the south-central area of the INEEL as shown in Figure 2-1.

The INTEC has been in operation since 1952. The plant's original mission was to reprocess uranium from defense related projects and to research and store spent nuclear fuel (SNF). The DOE phased out the reprocessing operations in 1992 and redirected the plant's mission to (1) receipt and temporary storage of SNF and other radioactive wastes for future disposition, (2) management of current and past wastes, and (3) performance of remedial actions.

The liquid waste generated from the past reprocessing activities is stored in an underground tank farm. The INTEC Tank Farm consists of eleven 1,135,624-L (300,000-gal) tanks, four 113,562-L (30,000-gal) tanks, four 68,137-L (18,000-gal) tanks, and associated equipment for the monitoring and control of waste transfers and tank parameters. One of the 1,135,624-L (300,000-gal) tanks is empty and serves as a spare tank in the event of an emergency. The majority of wastes stored in the tank farm are raffinates generated during the first-, second-, and third-cycle fuel extraction processes. These wastes include high-level wastes that are composed of first-cycle raffinates and intermediate-level wastes that are composed of second- and third-cycle raffinates blended with concentrated bottoms from the process equipment waste evaporator. This liquid waste continues to be treated by a calcining process to convert the waste into a more stable form and reduce the waste volume.

Numerous Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites are located in the area of the tank farm and adjacent to the process equipment waste evaporator. Contaminants found in the interstitial soils of the tank farm are the result of accidental releases and leaks from process piping, valve boxes, sumps, and cross-contamination from operations and maintenance excavations. No evidence has been found to indicate that the waste tanks themselves have leaked. The contaminated soils at the tank farm comprise about 95% of the known contaminant inventory at INTEC. The final comprehensive RI/FS for OU 3-13 (DOE-ID 1997a, 1997b, and 1998) contains a complete discussion of the nature and extent of contamination.

The SRPA underlies the eastern Snake River Plain and has been designated by the EPA as a sole source aquifer for the region. The basalts and sedimentary interbeds underlying INTEC, where continually saturated, are part of the SRPA. The aquifer lies at a depth of about 137 m (450 ft) beneath the site. Regional groundwater flow is southwest at average estimated velocities of 1.5 m/day (5 ft/day). The average groundwater flow velocity at the INTEC is estimated at 3 m/day (10 ft/day) due to local hydraulic conditions. Hydraulic characteristics of the aquifer differ considerably from place to place depending on the saturated thickness and the characteristics of the basalts and sedimentary interbeds.

The source of contamination in the SRPA originates primarily from the injection well (CPP-23). However, contaminated soils and perched water are predicted to contribute to future SRPA contamination. The iodine-129 (I-129), strontium-90 (Sr-90), and plutonium isotopes were determined to be the only contaminants that pose an unacceptable risk to a hypothetical future resident beyond the year 2095. The primary I-129 source was the former injection well. The primary Sr-90 source(s) were the former injection well and the tank farm soils. The primary source of plutonium isotopes is the tank

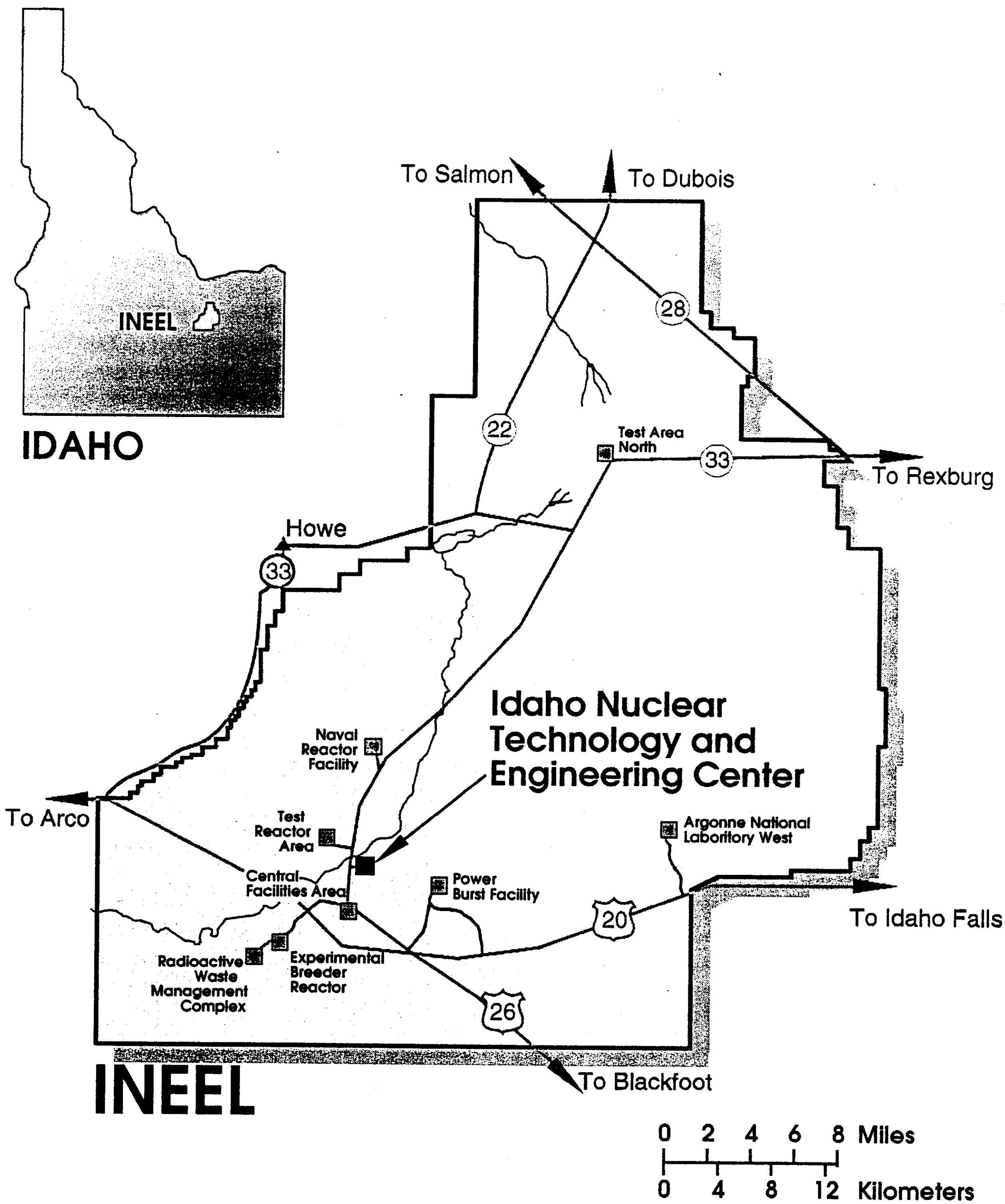

Figure 2-1. Map showing location of the INTEC at the INEEL.

farm. The major human health threat posed by contaminated SRPA groundwater is exposure to radionuclides via ingestion by future groundwater users.

Due to the uncertainty associated with the contaminant source estimates and potential releases from the tank farm soils, the remedial measures taken for the SRPA under OU 3-13 are designated as an interim action. The actions selected for the SRPA outside the current INTEC security fence are final actions. The evaluation and remedy selection for the SRPA inside the current INTEC security fence will occur under OU 3-14.

2.2 Conceptual Model

2.2.1 Geological and Hydrologic Setting

The INTEC northwest corner is approximately 46 m (150 ft) southeast of the Big Lost River channel, which flows along the northwest border of the INTEC facility boundary. As with much of the Big Lost River on the INEEL, the channel is typically dry at INTEC; however, the Big Lost River flowed during most of 1997 and 1998. At land surface, as much as 18.2 m (60 ft) of surficial alluvium is composed of gravelly, medium- to coarse-grained sediment. This alluviual material overlies a series of basalt/sediment units where the basalt is very transmissive, and the sediment units are relatively thin, much less transmissive, and laterally discontinuous, as shown on Figure 2-2. Below a depth of roughly 137 m (450 ft), the basalts are more massive, with one primary sedimentary interbed (HI interbed) below the water table which occurs at a depth approximately 168 m (550 ft) beneath INTEC. These deeper units comprise the SRPA under and southwest of INTEC. Regional groundwater flow in the area of INTEC is affected by local recharge as well as by locally high permeability basalts. The average groundwater flow velocity beneath INTEC is about 3 m/day (10 ft/day). See Sections 2.3 and 2.4 for detailed discussions of the hydrogeologic and geologic settings of the vadose and saturated zones.

2.2.2 Recharge Sources

As an operating facility, there are several sources of aquifer recharge at INTEC that include natural sources such as precipitation, infiltration, and intermittent flows of the Big Lost River, as well as anthropogenic water sources including the INTEC percolation ponds, sewage treatment ponds, lawn irrigation, and other miscellaneous sources. As this water infiltrates downward through the alluvium and the underlying transmissive basalts it is impeded by lenses of low permeability sediments and potentially by low permability basalt flows, creating local areas of higher water saturation or moisture content. In some instances, enough water is present in or on top of the sedimentary interbeds to form local perched water bodies (see Section 2.3).

The percolation ponds and the Big Lost River are the primary sources of recharge to perched water, comprising about 91% of the total perched water recharge at the INTEC. The percolation ponds contribute about 70% of the total perched water recharge. Percolation Ponds 1 and 2 are located outside the INTEC southern security fence, southeast of CPP-603. The percolation ponds are unlined wastewater disposal ponds that were excavated in the surficial alluvium in 1982 and 1985. The Big Lost River contributes about 21% of the total perched water recharge.

2.2.3 Contaminant Distribution and Transport

The SRPA has been contaminated by historical INTEC operational waste disposal activities. Release site CPP-23 (OU 3-02) consists of the former INTEC injection well, which was the primary means to dispose of service wastewater from 1952 to 1984 and is the primary source of contamination in the SRPA at INTEC (Fromm et al. 1994).

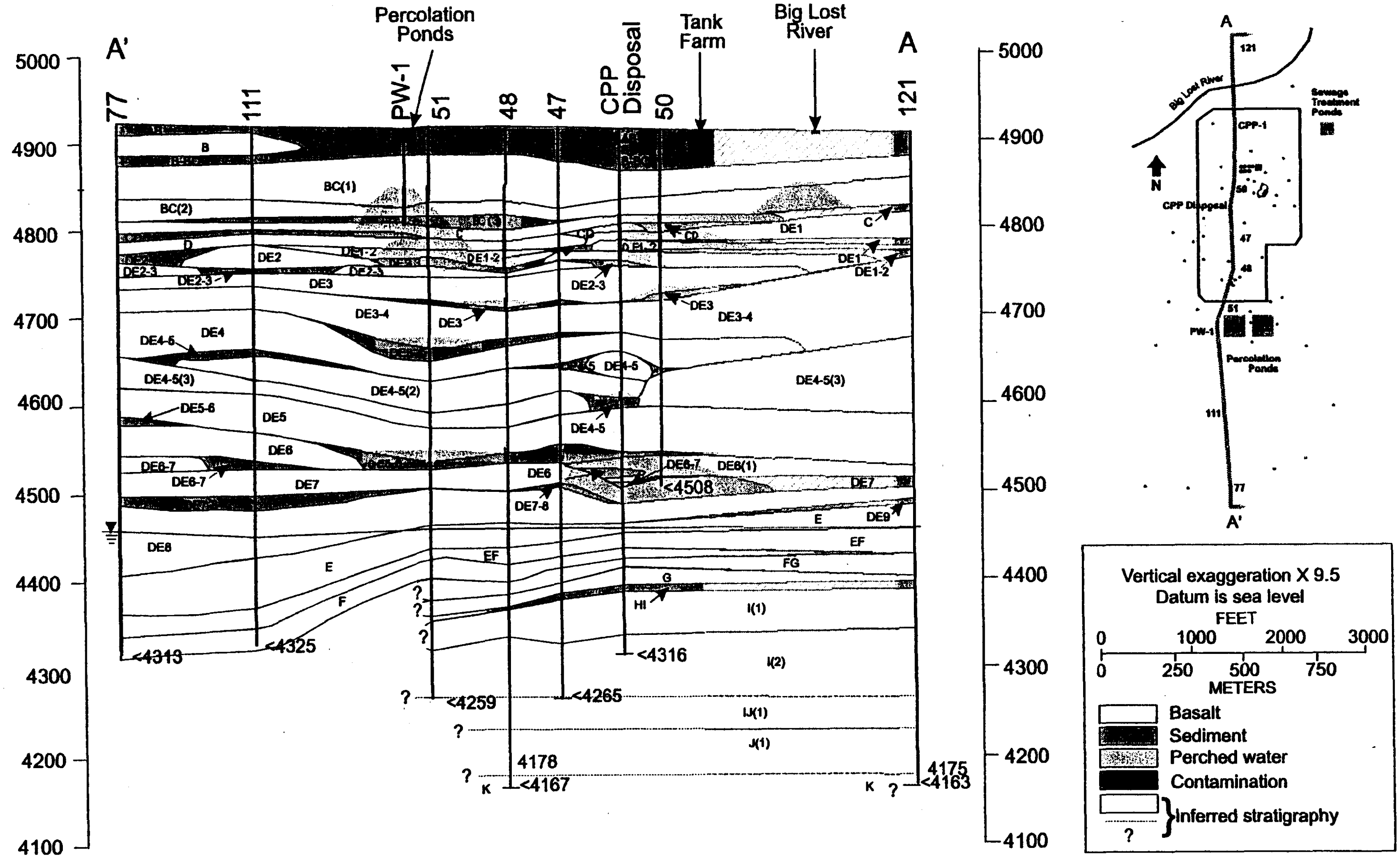

Figure 2-2. North-South cross-section through INTEC illustrating the perched water bodies, lithology, and water table of the SRPA.

In 1984, the well was removed from routine service and wastewater was subsequently discharged to the percolation ponds. After 1984, the well was used for emergency purposes in 1986 and was permanently sealed in 1989. In addition to the direct disposal of wastewater to the aquifer from the injection well, a second contaminant pathway to the SRPA is through the infiltration ponds at the surface through the vadose zone.

Radionuclides that were introduced into the aquifer from the former INTEC injection well include Pu-238, Pu-239, Pu-240, Sr-90, I-129, and tritium. Of these, tritium was the most common, comprising about 96% of the contaminant activity. At the time of injection, the radionuclides were generally below federally regulated levels. The injected wastewater also contained other (nonradioactive) chemicals including arsenic, chromium, mercury, and nitrates at concentrations below federal and state groundwater quality standards. Mercury, however, is estimated to exceed groundwater quality standards in the aquifer in the immediate vicinity of the former injection well but has not been detected in downgradient wells.

Contaminants are transported between contaminated surface soils and the SRPA by water infiltrating from the surface. Contaminants present in the recharge water and perched water in the upper portion of the vadose zone are primarily Sr-90 and tritium. Contamination in the lower portion of the vadose zone is different in composition and concentration than the upper zone. The lower vadose zone perched water was influenced and partially contaminated as a result of two events during which the INTEC injection well (CPP-23) collapsed and service wastewater was released into the vadose zone above the lower sediment units. Additional contamination in the lower perched water zone is the result of the transport of contaminants from the alluvial soils and upper perched water contamination. The lower vadose zone contamination includes Cs-137, Sr-90, I-129, plutonium, and mercury. Although contaminants are locally present in perched water, they are generally not available for consumption because of limited availability of that water. There are no water supply wells in the perched zone. Wells installed in the perched zone would not be capable of sustaining the pumping rates needed for future domestic water supplies, and as such, the perched water does not pose a direct human health threat, but impacts aquifer groundwater quality because it is a contaminant transport pathway between the contaminated surface soils and the SRPA.

Subsequent migration of these contaminants has produced several overlapping groundwater contaminant plumes, containing tritium, Sr-90, and I-129 currently occurring in groundwater beneath INTEC and extending downgradient for several miles. Short-lived (<30 year half-life) radionuclides, such as tritium, do not pose a long-term risk. Strontium is predicted to persist in the aquifer beyond 2095 at levels above the maximum contaminant level (MCL) if no action is taken. Iodine-129 has a very long half-life and is predicted in the WAG 3 RI/FS modeling to persist in the aquifer at concentrations exceeding MCLs.

2.3 Perched Water

Perched water bodies are significant because they increase the opportunity for contaminants to move both laterally and vertically in the vadose zone. This lateral water and contaminant movement in the vadose zone results in vertical migration rates that are spatially non-uniform beneath INTEC. Infiltration from the surface is assumed to move vertically through the basalt to an interbed. Because the interbeds are sloped, the water and contaminants migrate along the interbed and accumulate at interbed low points. This results in greater than average vertical water and contaminant fluxes in water accumulation areas and less than average vertical water and contaminant fluxes in the elevated portions of the interbed. Perched water bodies increase the complexity of flow and transport through the vadose zone.

Several zones of perched water have developed in the vadose zone as a result of site operations and natural recharge sources. The perched water bodies have been found in the following three zones in the subsurface:

1. The interface between the surface alluvium and the shallowest basalt flow.

2. An upper zone associated with the CD and DE3 interbeds at depths between 34 and 53 m (113 ft and 170 ft) below ground surface (bgs). This shallow zone is further subdivided into an upper shallow zone and a lower shallow zone.

3. A lower zone associated with the DE6 and DE8 interbeds at a depth of about 97 to 128 m (320 to 420 ft) bgs.

Figure 2-2 shows a geologic cross-section running from north to south through INTEC. The names of the basalt flows and interbeds are shown in the figure. Also depicted are locations where perched water is thought to exist. The perched water has varying degrees of radionuclide concentrations, with the northern upper perched zone showing the highest concentration levels.

2.3.1 Perched Water in Surficial Alluvium

In places with a concentrated source of surface recharge, a perched water zone can develop in the surficial alluvium on top of the first basalt flow. Perched water has been identified in the alluvium beneath the INTEC surface disposal ponds (the percolation ponds and the sewage treatment pond). A small perched water table in alluvium was encountered west of CPP-603. The source for the perched water west of CPP-603 was assumed to be wastewater that was discharged to a shallow seepage pit (Robertson et al. 1974).

Perched water in the surficial alluvium requires a concentrated source of recharge that exceeds the normal recharge provided by precipitation. Perched water has not been widely measured at the sediment-basalt interface beneath INTEC and is not believed to be present there.

2.3.2 Upper Perched Water Zone

The upper perched water zone occurs as several distinct water bodies, perching on several different sedimentary interbeds (see Figure 2-2). The upper portion of the shallow upper perched water body is above the CD and D interbeds. The lower portion of the upper perched water body is on the DE3 interbed. The CD interbed occurs at depths between 34 and 36 m (113 and 119 ft) bgs, the D interbed occurs at depths between 39 and 41 m (128 and 135 ft) bgs, and the DE3 interbed occurs at depths between 50 and 52 m (163 and 170 ft) bgs.

The upper perched water zone is frequently considered to be divided into northern and southern zones because it appears to be two discrete water bodies. Because the perched water boundaries are not well defined, the actual extent of the perched water bodies could be quite different than assumed. Even within the upper zones, the zones appear to occur as fragmented rather than continuous perched water bodies. The connections between the perched water bodies are not well understood. Based on the upper perched water configuration, it appears that multiple water sources are providing recharge to the upper perched water body in the northern portion of INTEC. These sources may include recharge from the Big Lost River, the waste water treatment lagoons, and operational releases.

2.3.3 Lower Perched Water Zone

A deep perched water zone has been identified in the basalt between 98 and 128 m (320 and 420 ft) bgs. This was first discovered in 1956 when perched groundwater was encountered at a depth of 106 m (348 ft) while drilling the United States Geological Survey (USGS) Well USGS-40 (Robertson et al. 1974) (see Figure 2-3). Since then, perched water has been encountered in this zone during the drilling of several INTEC facility wells.

Only four monitoring wells are completed in the deep perched water zone. Wells MON-P-001, MON-P-018, and USGS-50 are completed in the northern portion of the facility, and water has been encountered at approximately 85, 107.5, and 101 m (322, 407, and 383 ft) bgs, respectively. In the southern portion of the INTEC facility, only Well MON-P-017 is completed in the lower perched water zone in which water is encountered at a depth of approximately 96 m (364 ft) bgs.

Similar to the upper perched water zone, it is thought that the lower perched water zone is formed by decreased permeability associated with sedimentary interbed layers. It appears that the lower perched water has formed primarily on the DE7 interbed (see Figure 2-2). The top of this interbed occurs beneath the INTEC at depths ranging from 101 to 112.5 m (383 to 426 ft) bgs in the western portion of the INTEC facility. However, the DE6 interbed is also responsible for creating perched water, which is associated with Wells USGS-40 and USGS-43. The lower perched water zone is not continuous beneath the entire facility and may actually consist of several individual perched water bodies. Recharge to the southern perched water body is from service wastewater discharged to the percolation ponds. The source of recharge to the western portion of the northern perched water body is unknown, though the Big Lost River and facility water leaks are likely contributors.

2.4 Snake River Plain Aquifer

2.4.1 Regional Hydrogeology

The SRPA is about 322 km (200 mi) long and 89 to 113 km (55 to 70 mi) wide. It extends from Ashton and the Big Bend Ridge on the northeast to Hagerman on the southwest and covers about 25,900 km^2 (10,000 mi^2). The aquifer consists of a series of basalt flows with interbedded sedimentary deposits and pyroclastic materials. The boundaries are formed by the contacts of the aquifer with less permeable rock at the margins of the plain (Mundorff et al. 1964). Robertson et al. (1974) estimated that as much as 2 billion acre-ft of water may be in storage in the aquifer, of which about 500 million acre-ft are recoverable.

Groundwater in the SRPA generally occurs under unconfined conditions, but locally may be quasi-artesian or artesian (Nace et al. 1959). The quasi-artesian or artesian conditions are caused by layers of dense, massive basalt or sediments with relatively low permeability. Nace et al. (1959) described quasi-artesian as the situation in which the groundwater level is first recognized in a borehole during drilling at a depth below the regional water table, and then the level rises significantly (1.5 to 15.2 m [5 to 50 ft]) to the level of the water table. This rise of the water level simulates artesian pressure, but the conditions are not truly artesian. Nace et al. (1959) also noted water levels in some wells in the SRPA respond to fluctuations in barometric pressure similar to wells in confined aquifers, indicating that tight zones in the basalt may impede pressure equalization. True artesian or flowing artesian conditions in the SRPA were identified at Rupert, in parts of the Mud Lake Basin, and north of the American Falls Reservoir (Nace et al. 1959).

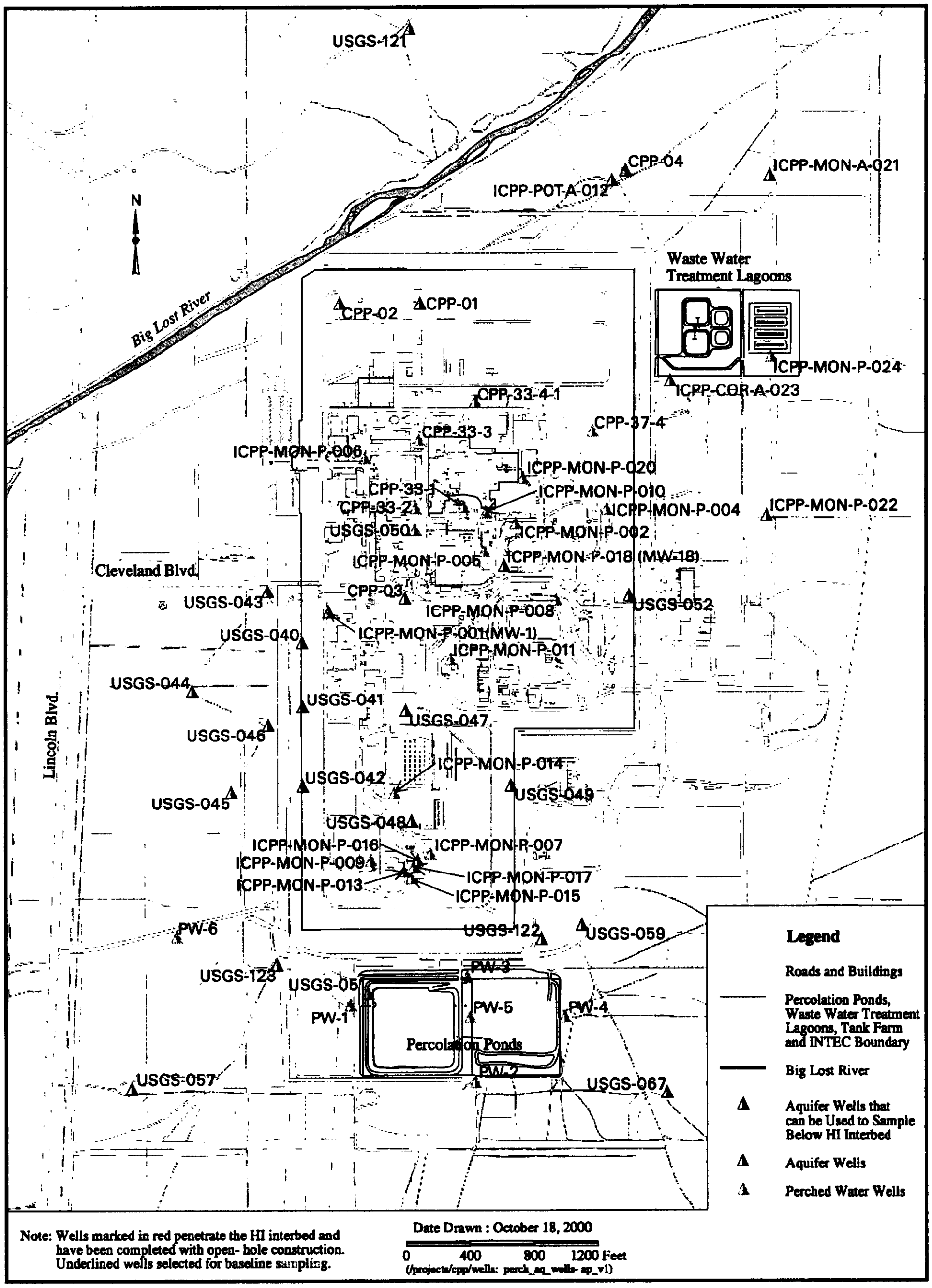

Figure 2-3. Locations of wells completed in the perched and groundwater zones.

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Recharge to the aquifer is primarily by valley underflow from the mountains to the north and northeast of the plain and from infiltration of irrigation water. A small amount of recharge occurs directly from precipitation. Recharge to the aquifer within INEEL boundaries is primarily by underflow from the northeastern part of the plain and the Big Lost River (Bennett 1990). Significant amounts of recharge from the Big Lost River have caused water levels in some wells at the INEEL to rise as much as 1.8 m (6 ft) within in a few months after high flows in the river (Barraclough et al. 1982). Locally, the direction of groundwater flow is temporarily changed by recharge from the Big Lost River (Bennett 1990).

Estimates of the effective thickness of the SRPA at the INEEL vary. A 3,159-m (10,365-ft) deep geothermal test well (INEL-1) was drilled about 7.2-km (4.5-mi) north of the INTEC in 1979. Subsurface geologic information from INEL-1 indicates at least 610 m (2,000 ft) of basalt underlie the INEEL (Prestwich and Bowman 1980). Hydrological data from INEL-1 were interpreted by Mann (1986) to indicate the effective base of the aquifer is 259 to 372 m (850 to 1,220 ft) bgs. The depth to water at INEL-1 is about 122 m (400 ft) bgs, which suggests an effective aquifer thickness of 137 to 250 m (450 to 820 ft). In earlier studies by Robertson et al. (1974), the effective portion of the SRPA at the Test Reactor Area (TRA) was assumed to be the upper 76 m (250 ft) of the saturated zone based on lithology and water quality. The aquifer thickness varies at different areas, and the aquifer becomes less productive with depth due to decreasing hydraulic conductivity (Hull 1989). Hydraulic conductivity of the basalt in the upper 244 m (800 ft) of the aquifer generally is 0.3 to 30.5 m/day (1 to 100 ft/day); whereas, the hydraulic conductivity of underlying rocks is several orders of magnitude smaller (Orr and Cecil 1991). Fracture filling from sediments and secondary mineralization are the principal reasons for the decreased hydraulic conductivity.

Water level elevations generally range from 1,399 m (4,590 ft) above median sea level in the northern part of the INEEL to about 1,347 m (4,420 ft) above median sea level south of the INEEL with the depth to the water table varying from about 61.0 m (200 ft) bgs in the northern part of the INEEL to about 274 m (900 ft) bgs in the southern part. The general direction of groundwater flow is to the south-southwest, and the average gradient is about 0.8 m/km (4 ft/mi) (Orr and Cecil 1991). Locally, however, the hydraulic gradient varies significantly and ranges from about 0.2 m/km (1 ft/mi) in the northern part of the INEEL to a maximum of 2.8 m/km (15 ft/mi). The elevation of the water table and direction of groundwater flow are affected by recharge, groundwater withdrawal, and variations in aquifer transmissivity. The effects of groundwater withdrawal are often localized in contrast to recharge and transmissivity variations that have regional impacts. From July 1985 to July 1988, Orr and Cecil (1991) reported water level changes in INEEL wells ranging from a 7.9-m (26-ft) decline near the Radioactive Waste Management Complex to a 1.2-m (4-ft) rise north of Test Area North. Water levels generally declined in the southern two-thirds of the INEEL during that time and rose in the northern one-third.

Hydraulic properties of the SRPA have been determined by pumping tests. Robertson et al. (1974) reported transmissivities ranging from 1.24×10^4 to 1.24×10^6 m^2/day (1.34×10^5 to 1.3×10^7 ft^2/day) with 6.2×10^4 m^2/day (6.7×10^5 ft^2/day) considered normal. By calculating the geometric mean of transmissivity values, Hull (1989) estimated regional aquifer transmissivity for the southern INEEL to be 27,000 m^2/day (294,000 ft^2/day). Estimates of the storage coefficients range from 0.01 to 0.06 and effective porosity from 5 to 15%, with 10% being historically the most accepted value (Robertson et al. 1974), though more recent information indicates that a lower value may be appropriate.

2.4.2 INTEC Hydrogeology

Sixty-eight wells have been installed at the INTEC to monitor perched water bodies and the SRPA. This monitoring well network consists of 32 wells completed in the perched water zones and 36 wells completed in the SRPA. Several of the perched water monitoring wells are completed in multiple water bearing zones. The locations of wells completed in the perched and groundwater zones are shown in Figure 2-3, with the construction specifications provided in Appendix A.

Water level elevations indicate two separate sources of local recharge to the SRPA. One source for recharge is apparently from the percolation ponds as indicated by elevated water levels measured in Wells USGS-51, -112, -113, -114, -115, and -116. Water level response to recharge from these ponds is indicated by a 0.6 m (2 ft) rise in Well USGS-113 and a 0.3 m (1 ft) rise in Well USGS-51. The water table in the SRPA downgradient from the percolation ponds has a bimodal shape, indicating a preferred flow direction toward the southwest with a secondary flow component to the southeast.

Directly south of the ponds, water levels in Wells USGS-77 and USGS-111 are significantly lower than what would be expected based on the water levels in the adjacent wells. The reason(s) for the anomalously low water levels in these two wells is attributed to local variations in the water-bearing characteristics of the SRPA (see Section 2 of the remedial investigation/baseline risk assessment (RI/BRA) report [DOE-ID 1997a]). A second possible source of recharge to the SRPA may be indicated by anomalously high water levels measured in Well USGS-47. The water levels measured in Well USGS-47 are consistently 0.3 to 0.6 m (1 to 2 ft) higher than corresponding water levels measured from the surrounding wells. The possible causes of the anomalously high water levels include local recharge, local pumping, vertical hydraulic gradient (i.e., increasing hydraulic head with depth), and well completion characteristics.

The local groundwater flow appears complex and is apparently affected by local recharge, variations in hydraulic conductivity, local pumping, and possibly vertical hydraulic gradients. Groundwater directly beneath INTEC generally flows to the southwest and southeast, with a minor flow component to the south. The local flow pattern likely results from local recharge (i.e., percolation ponds and sewage ponds) that creates the mounding in the water table, and possibly from pumping the production wells. As the groundwater progresses beyond the influence of INTEC, it flows toward the southwest. The local hydraulic gradient is low, only 0.2 m/km (1.2 ft/mi) compared to the regional gradient of 0.8 m/km (4 ft/mi).

2.4.2.1 Local Flow Velocity. Tritium from INTEC wastes has been used extensively in tracing groundwater flow velocities and directions (Morris et al. 1964; Hawkins and Schmalz 1965; and Barraclough et al. 1967). Peaks of high tritum discharge to the disposal well have been particularly useful in determining the local flow characteristics in the SRPA. One of the most studied peak discharges of tritum occurred in December 1961 because it was preceded and followed by relatively long periods of low tritum discharge.

The concentration of the tritum peak as it passed each observation well provides an indication of the amount of dispersion the slug has undergone. The tritum concentration distribution indicates two preferred flow paths from the disposal well probably exist: (1) the predominant path to the southwest and (2) a less clearly defined path to the southeast. Some of the explanation for this phenomenon is provided in the plot of the transmissivity values for INTEC where a zone of low transmissivity is located directly to the south. This zone of low transmissivity to the south apparently acts as a barrier to impede the local groundwater flow.

2.4.2.2 Groundwater Pumping Effects. The INTEC facility uses approximately 7.9 million L (2.1 million gal) of water per day. This water is supplied by two raw water wells (CPP-1 and CPP-2) and two potable water wells (CPP-4 and new well) located in the northern portion of the facility. As part of the WAG 3 remedial investigation, the effect of pumping groundwater from these wells upon the local water table was investigated during July and August 1995. This investigation involved continuous water level monitoring of several aquifer wells completed in the northern section of INTEC while metering the pump usage in Production Well CPP-2.

Water level fluctuations in six aquifer wells (MW-18, USGS-40, -43, -47, -52, and -121) were monitored at 5-minute intervals using pressure transducers and data loggers. The National Oceanic and Atmospheric Administration recorded barometric pressure changes at 5-minute intervals at the Central Facilities Area weather station, which is located approximately 5 km (3 mi) from the test site. Pump usage for Well CPP-2 was continuously monitored based on amperage requirements. During the 11 days of the test, the production well pump turned on 17 times with each pump cycle lasting for approximately 9 hours.

The water levels in all aquifer wells exhibited a similar response. Daily fluctuations, generally less than 3 cm (1 in.), were observed in all aquifer wells corresponding with pump usage of the production well. In almost all pump cycles, the corresponding water levels in the aquifer wells decreased by an average of 1.9 cm (0.75 in.). Only Pump Cycle #11 demonstrated an increase in water levels throughout the pump duration for all wells except Well USGS-40. This water level increase during this pump cycle may be the result of a local or regional trend and not related to pumping groundwater. Other than Pump Cycle #11, the water levels decreased during the pump cycle in Wells MW-18, USGS-40, -43, and -52 throughout the test.

As shown by this test, water levels in the SRPA are affected by pumping groundwater from the production well. Minimal responses (<2.5 cm [<1 in.]) were observed in these six monitoring wells; however, the wells are located approximately 610 m (2,000 ft) from the production well. Increased drawdown would be expected closer to the production well that could affect the local groundwater flow direction in the northern sections of INTEC.

2.4.2.3 Hydraulic Conductivity. The hydraulic conductivity of the SRPA in the vicinity of INTEC was estimated using the transmissivity values reported by Ackerman (1991) and the saturated thickness of the open interval of the well (Table 2-1). The estimation of hydraulic conductivity assumes the wells fully penetrate the saturated thickness of the aquifer. Hydraulic conductivities range five orders of magnitude with a maximum hydraulic conductivity of 3.0×10^3 m/day (1.0×10^4 ft/day) at Well CPP-3 and a minimum hydraulic conductivity of 3.0×10^{-2} m/day (1.0×10^{-1} ft/day) at Well USGS-114. The average hydraulic conductivity within the immediate vicinity of INTEC is $4.0 \times 10^2 \pm 7.9 \times 10^2$ m/day ($1.3 \times 10^3 \pm 2.6 \times 10^3$ ft/day). Using the average hydraulic conductivity, a hydraulic gradient of 1.2 m/km (6.3 ft/mi) (Orr and Cecil 1991), and an effective porosity of 10%, the calculated seepage velocity in the vicinity of the INTEC is approximately 3 m/day (10 ft/day).

2.5 Contaminants of Concern

The water quality in the SRPA at and downgradient from INTEC has been adversely impacted due to past facility operations. The SRPA (Group 5) is identified as containing low-level threat wastes. The COCs identified in the OU 3-13 baseline risk assessment are primarily radionuclides and include Sr-90, tritium, Cs-137, I-129, plutonium isotopes (Pu-238, -239, -240, and -241), uranium isotopes (U-234, -235, and -238), Np-237, Am-241, and Tc-99. In addition, mercury was identified as a COC.

It has been estimated a total of 22,000 Ci of radioactive contaminants have been released in 4.2×10^{10} L (1.1×10^{10} gal) of water (DOE-ID 1997a). The vast majority of this radioactivity is attributed to tritum (approximately 96%) with minor components of Am-241, Tc-99, Sr-90, Cs-137, Co-60, I-129, and plutonium. In May and June 1995, groundwater samples were collected from the aquifer wells located near and downgradient from the INTEC. The results from this sampling effort are provided in Table 2-2.

Table 2-1. Transmissivities in the SRPA near the INTEC (Ackerman 1991) and estimates of hydraulic conductivity.

Well Identifier	Transmissivity (ft^2/day)	Saturated thickness [a] (ft)	Hydraulic conductivity (ft/day)
CPP-1	7.3×10^4	150	4.9×10^2
CPP-2	1.6×10^5	75	2.1×10^3
CPP-3	7.6×10^5	74	1.0×10^4
CPP-4	2.5×10^2	255	9.8×10^{-1}
USGS-37	1.6×10^4	65	2.5×10^2
USGS-40	8.7×10^4	27	3.2×10^3
USGS-43	8.0×10^4	225	3.6×10^2
USGS-51	2.9×10^3	184	1.6×10^1
USGS-57	2.8×10^4	255	1.1×10^2
USGS-82	5.6×10^4	100	5.6×10^2
USGS-111	2.2×10^1	137	1.6×10^{-1}
USGS-112	6.4×10^4	96	6.7×10^2
USGS-113	1.9×10^5	97	2.0×10^3
USGS-114	1.0×10^1	100	1.0×10^{-1}
USGS-115	3.2×10^1	123	2.6×10^{-1}
USGS-116	1.5×10^2	127	1.2×10^0
Maximum	7.6×10^5		1.0×10^4
Minimum	1.0×10^1		1.0×10^{-1}
Average ± Standard Deviation (SD)	9.5×10^4 $\pm 1.9 \times 10^5$		1.3×10^3 $\pm 2.6 \times 10^3$

a. Saturated thickness values are the total saturated portion of the open well interval.

Table 2-2. Summary sampling results statistics for contaminants in the SRPA Wells (May-June 1995).[a]

Contaminants	Water Concentration, mg/L or pCi/L Minimum	Maximum	PRG[b]	Number of Samples	Number of Detects	Frequency of Detection
Ag	6.30E-04 BNJ	8.80E-04 BNJ	1E-01[c]	38	3	8%
As	3.10E-03 B	1.08E-02 B	5E-02	42	3	7%
Ba	5.00E-02 B	2.05E-01	2E+00	42	42	100%
Cd	4.80E-04 B	3.00E-03 B	5E-03	42	4	10%
Co	5.20E-04 B	1.40E-03 B	NA	42	8	19%
Cr	1.80E-03 B	3.88E-02	1E-01	42	31	74%
Cu	1.60E-03 BJ	3.20E-03 B	1.3E+00	42	7	17%
Hg	1.00E-04 B	4.40E-04	2E-03	42	7	17%
Mn	8.40E-04 B	6.28E-02	5E-02[c]	42	10	24%
Ni	4.30E-03 B	2.06E-01	NA	42	6	14%
Pb	2.30E-03 BWJ	3.77E-02	1.5E-02	42	10	24%
Sb	1.90E-03 B	4.60E-03 B	6E-03	42	3	7%
Se	1.40E-03 B	3.70E-03 B	5E-02	42	7	17%
V	2.30E-03 B	9.90E-03 B	NA	42	24	57%
Zn	2.60E-03 B	4.54E-01 IJ	5E+00[c]	42	27	64%
Am-241	5.40E-01	5.40E-01	<1.5E+01[d]	49	1	2%
I-129[e]	9E-07	3.82E+00	1E+00[d]	33	32	94%
Sr-90	7.00E-01	8.40E+01	8E+00	70	49	70%
Tc-99	1.10E+00	4.48E+02	9E+02[d]	70	57	81%
Tritium	5.81E+02	3.07E+04	2E+04	49	45	92%
U-234	7.00E-01	2.60E+00	1.5E+01[f]	49	7	14%

Table 2-2. (continued).

Contaminants	Water Concentration, mg/L or pCi/L Minimum	Maximum	PRG[b]	Number of Samples	Number of Detects	Frequency of Detection
U-238	8.00E-01	1.10E+00	1.5E+01[f]	49	4	8%
Gross Alpha	2.30E+00	1.00E+01	1.5E+01[g]	49	20	41%
Gross Beta	2.40E+00	4.69E+02	4mR/yr[h]	49	49	100%

a. NOTE:

- Duplicate and QC sample results were not included in the statistical analysis.
- Analytical results are from groundwater samples collected from the SRPA during May and June 1995 as part of the OU 3-13 RI. Results are provided in Table 4-4 of the OU 3-13 RI/FS Part A (DOE-ID 1997a) and the ERIS Database.
- Samples were analyzed for TAL inorganics and radionuclides. Only those constituents that were identified above detection limits in the samples are shown in the table except for the following constituents which were detected but are not considered to be present at hazardous concentrations: Ca, Fe, Mg, K, and Na.
- Samples rejected because of an unacceptable quality control parameter were not included in the table.

b. The PRG concentrations are from the Primary Constituent Standards table in IDAPA 58.01.11.200(a) unless otherwise footnoted.

c. The PRG concentrations for manganese, silver, and zinc are from the Secondary Constituent Standards in IDAPA 58.01.11.200 (b).

d. The PRG concentrations for Am-241, I-129, and Tc-99 are calculated values based on the National Interim Primary Drinking Water Regulations (EPA 1976).

e. Summary sampling data for I-129 was taken from data collected during the 1990-91 USGS sampling event (DOE-ID 1994). The data shown in the table is only from those wells sampled both during the 1990-91 USGS sampling event and the WAG 3 RI/FS, May–June 1995, sampling event.

f. The PRG concentrations for U-234 and U-238 are from Section 8, Table 8-2 of the ROD (DOE-ID 1999).

g. The PRG concentration for gross alpha includes radium-226 but excludes radon and uranium.

h. The PRG concentration for gross beta (combined beta/photon emitters) is 4 mr/yr effective dose equivalent.

B = Contaminant in associated blank.

I = The reported value is estimated because of the presence of interference.

J = Estimated concentration.

N = Spiked sample recovery was not within control limits.

W = Post-digestion spike for GFAAS analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.

NA = Not applicable.

PRG = Preliminary Remediation Goal.